Space Weather Technical Forecast

Issued on Friday, 13 September 2024 at 01:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: G1-G2 Minor to Moderate geomagnetic storms likely day 2 (14th Sep). Moderate to High solar activity.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Has been High with peak flare X1.3 at 12/0943 UTC from a new region that has rotated onto the southeast limb. There are eight sunspot regions, including this one, with four of these forming a cluster of small and magnetically simple sunspots in the southwest disc. AR3811 has now rotated off behind the west limb, and was the source of an M5.0 flare at 12/0022 UTC, but continues produce magnetic looping and brightness in imagery. AR3814 in the northwest is a significant region, with a weak delta spot ahead of its main large symmetrical trailer spot. The new region on the southeast limb is likely to have a complex magnetic structure, potentially more so than AR3814, and will be analysed once the region rotates further onto the visible disc.
There were no Earth-directed CMEs observed in this period.

Solar Wind / Geomagnetic Activity: Two CMEs were observed arriving at L1, the first from the 08 Sep CME at 11/1425 UTC which arrived at 12/0253 UTC. The second. which is likely to be an early arrival of the 10 Sep CME at 12/0253 UTC, perhaps arriving in separate shock and material components, reached L1 at 12/0820 UTC. Solar wind speed from ACE at L1 rose from around 350 km/s to around 440km/s with the first CME arrival, and there after continued to rise in steps to peak at 623 km/s at 12/1714 UTC. Later in the day the solar wind declined slightly to around 520 km/s. Density rose above average with the arrival of the first CME, and then varied between average and above average levels after the second arrival, before declining late in the day to below average levels. The Interplanetary Magnetic Field (IMF), Bt, was initially Weak, but increased to Moderate with the arrival of the first CME. This rose further with the second CME, becoming Strong, with peak of 29 nT at 12/1305 UTC. The north-south component remained unremarkable with the first arrival, but became mainly negative (southward) from 12/0340 UTC with brief positive (northward) spells, with periods of Moderate to Strong southward field. This ranged +16 to -26nT with minimum at 12/1306 UTC. The phi angle was variable at times, but mainly positive (away from the Sun). Geomagnetic activity was Active (Kp 4) with the first arrival, but after the second arrival increased to G2/Moderate (Kp 6) storm levels between 12/0900-1800 UTC and then G3/Strong (Kp 7) storm levels 12/1800-2100 UTC, then declining to G1/Minor Storm (Kp 5) levels late to end the day.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained steady and close to background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background to moderate levels, with a peak of 332 pfu at 11/2000UTC. The associated 24-hour fluence remained below the Active threshold, with a declining trend and with 9.82e6 integrated pfu observed at 13/0000UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: High to moderate activity expected with M-class flares expected and a slight chance of further X-class flares.

Solar Wind / Geomagnetic Activity: Current CME influence is expected to ease through today (13 Sep), before a further arrival is anticipated. This is from the M1.0 flare CME from AR3814 on the north disc at 10/2350 UTC. This is forecast to arrive either very late today, but more likely early on day 2 (14 Sep). Coronal hole fast winds could potentially arrive day 3 (15 Sep) from CH68/- in the north disc and continue through day 4 (16th). Geomagnetic activity is expected to be Active to G1/Minor Storm at first today (13 Sep), with a chance of an isolated G2 Moderate Storm intervals, before easing to Quiet to Active later today. With the next CME arrival G1-G2/Minor-Moderate Storms are likely, especially early day 2 (14th Sep). Quiet to Active conditions develop later day 2(14th Sep), and persist through day 3 and 4 (15th and 16th) with a chance of G1/Minor geomagnetic storms from the HSS.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain near background with a slight chance of rising given any notable flares, mainly from the regions on the southwest disc. High energy electron flux is expected to remain mainly at Background with the associated 24 hour fluence remaining below Active.

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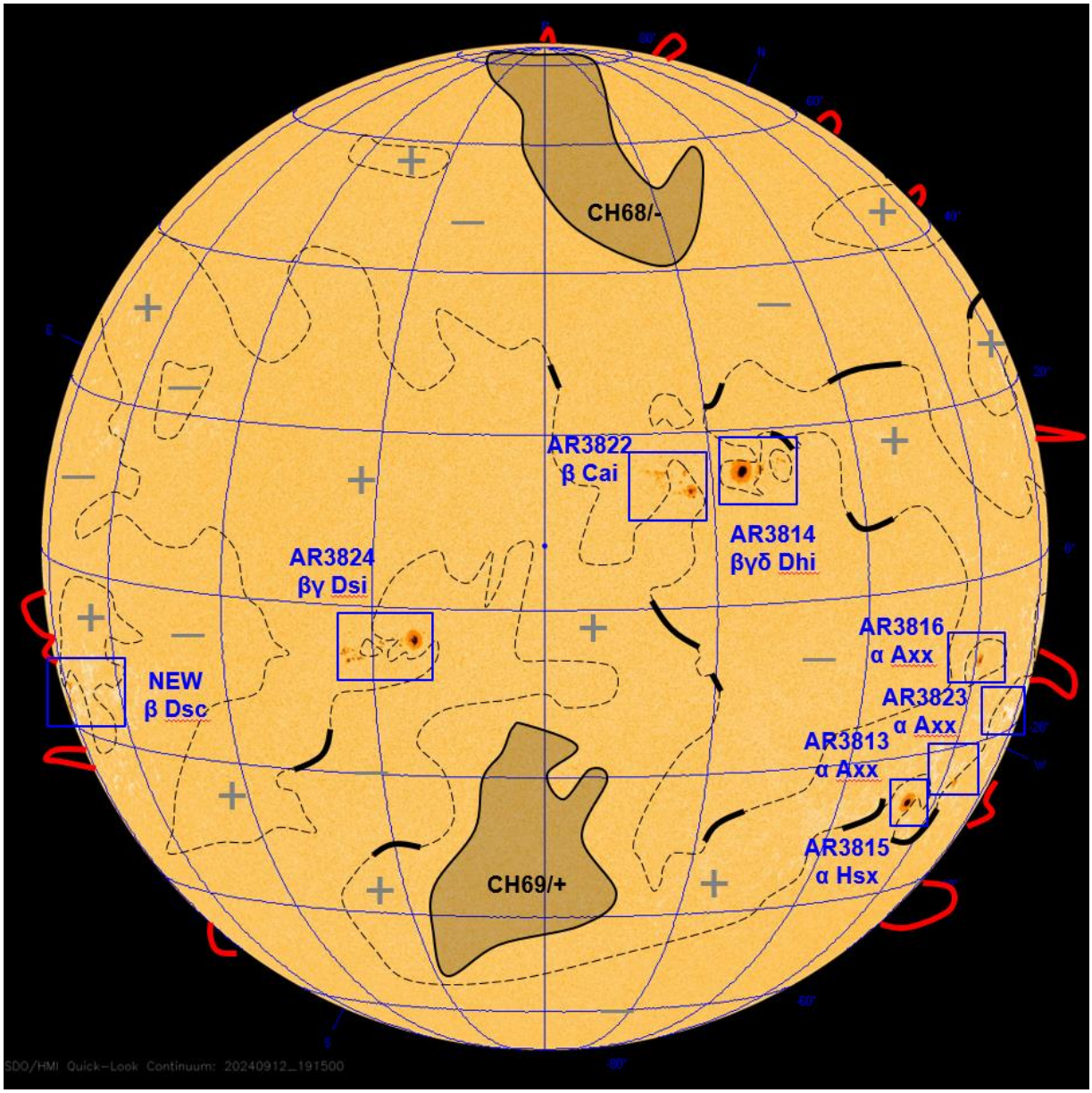
Figure 1. Solar Analysis Valid 12/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Earth remains within the CME influence from the arrival at 12/0253 UTC. This has been attributed to an early arrival of the 10/0029 UTC CME, although due to how early this arrived compared to the forecast this is only Moderate confidence. However there are no other clear candidate CMEs for this arrival.
There is a further Earth-directed CME which was observed leaving the Sun around 10/2350 UTC, due to an M1.0 flare from AR3814. This is a relatively diffuse CME, and has lower confidence due to limited available LASCO imagery, but based on STEREO A cor2 imagery is currently forecast to arrive either very late today (13 Sep) or more likely early tomorrow (14 Sep).
The northern coronal hole feature is also likely to connect later in the period, most likely day 3 (15 Sep), although this is also low confidence, due to only a limited response on MOSWOC Enlil and the northern latitude of the feature.
Geomagnetic activity is expected to be Active to G1/Minor Storm at first today (13 Sep), with a chance of an isolated G2 Moderate Storm intervals, before easing to Quiet to Active later today. With the next CME arrival G1-G2/Minor-Moderate Storms are likely, especially early day 2 (14th Sep). Quiet to Active conditions develop later day 2(14th Sep), and persist through day 3 and 4 (15th and 16th) with a chance of G1/Minor geomagnetic storms from the HSS.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	80	70	30	10
Strong	G3	Yes	5	5	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
11/0657	Partial	M1 flare	AR3814 NW	709	14/0100 UTC	Low confidence
*	*	*	*	*	*	*

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Radio Blackouts - X-Ray Flares:

There are eight sunspot regions visible with previous region AR3820 having decayed from sight, and AR3811 now rotated out of view onto the west limb. However, AR3811 remains bright in SDO AIA 94, imagery with significant magnetic looping evident above the spot, despite the unfavourable viewing angle. Three spots small and magnetically simple regions in the southwest quadrant are becoming harder to assess as they approach this limb. AR3814, in the northwest is one of two regions of interest on the visible disc. This region has a main simple and symmetric trailer spot but a beta-gamma-delta classification, due to mixed polarity intermediate spots ahead of this. One of the intermediate spots has recently decreased in penumbra size, and the delta spot within this penumbra is now very small and weak. The remaining regions are generally simpler, apart for the new region on the southeast limb. This region has the potential to become analysed, once further into the southeast quadrant, as a complex region and this is supported by looping seen in SDO imagery.
Activity has been High with a peak of X1.3 at 12/0943 UTC from a new region on the southeast limb that has yet to properly assessed. An M5.0 flare was also observed from AR3811 on the west limb at 12/0012 UTC, and nine other M-flares observed, with some of these doubled peaked or long duration. Moderate to High activity is expected to continue with a further M-class flares expected and a slight chance of X-class flares, mainly due to the new region on the southeast limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	75	75	70	70
Very Active	R3 to R5 X Class	Yes	20	20	15	15

Solar Radiation Storms - (High Energy Protons):

High energy proton flux is now near background, having shown a steady decline after recent enhancements. There remains a slight chance of any further enhancements exceeding the S1 Minor Radiation Storm level, mainly due to the number of sunspots on the southwest disc, but most notably AR3811 that is behind the western limb. The decreasing risk from this region will be compensated by AR3814 moving into a better connected location for Earth-directed proton enhancements.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	15	15	15	15

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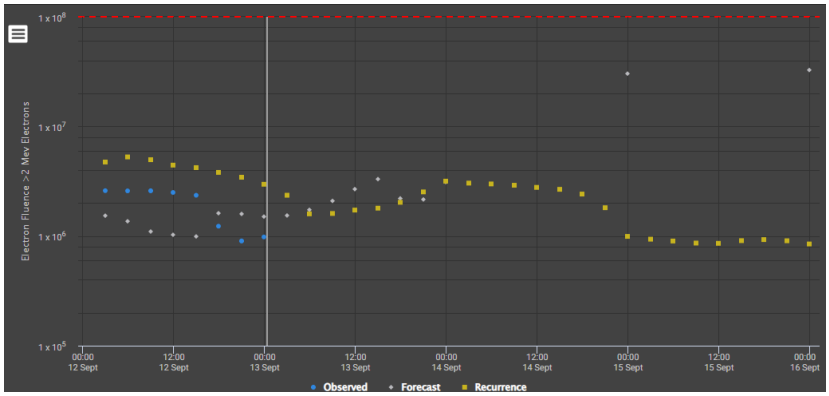
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy electron flux is currently at background. Recent CME arrival will have suppress the observed counts at GEO, although some charging is likely at lower orbits. With a further CME arrival anticipated later day 2 or early day 3 (13-14 Sep), and the potential for onset of coronal hole fast winds day 3 (15 Sep), any periods of Moderate flux at GEO are expected to be brief, with mainly Background flux persisting.
The associated 24-hour fluence is expected to remain below the Active level, as shown by the MOSWOC REFM, although the increasing trend that is indicated is not expected.

GEO Electron Environment	**Level (cm^{-2} sr^{-1} day^{-1})**	**Past 24 Hours (Yes/No)**	**Day 1 (00-24 UTC)**	**Day 2 (00-24 UTC)**	**Day 3 (00-24 UTC)**	**Day 4 (00-24 UTC)**
Probability (Exceedance)			**(%)**	**(%)**	**(%)**	**(%)**
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 2: Latest MOSWOC REFM



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